

ICS 83.080.01

CCS G 31



**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GB/T 41932-2022**

---

**Plastics - Determination of fracture toughness(GIC and KIC) -  
Linear elastic fracture mechanics (LEFM) approach**

**Issued on: December 30, 2022**

**Implemented on: April 1, 2023**

---

**Issued by: State Administration for Market Regulation, China National  
Standardization Administration**

## Table of Contents

|                                                                                                  |    |
|--------------------------------------------------------------------------------------------------|----|
| Preface                                                                                          |    |
| 1 Scope                                                                                          | 1  |
| 2 Normative references                                                                           | 1  |
| 3 Terms and Definitions                                                                          | 1  |
| 4 symbols                                                                                        | 3  |
| 5 Sample                                                                                         | 4  |
| 6 State regulation and test environment                                                          | 5  |
| 7 Instruments and equipment                                                                      | 6  |
| 8 Test Step                                                                                      | 7  |
| 9 Calculation and presentation of results                                                        | 9  |
| 10 Precision                                                                                     | 11 |
| 11 Test report                                                                                   | 12 |
| Appendix A (Informative) Comparison between this document and ISO 13586.2018<br>structure number | 13 |
| Appendix B (informative) Tests for plastics containing short fibers                              | 14 |
| Appendix C (Normative) Correction factor                                                         | 17 |
| Reference                                                                                        | 19 |

### foreword

This document is in accordance with the provisions of GB/T 1.1-2020 "Guidelines for Standardization Work Part 1. Structure and Drafting Rules for Standardization Documents" drafting.

This document is modified to adopt ISO 13586.2018 "Determination of Fracture Toughness (GIC and KIC) of Plastics Linear Elastic Fracture Mechanics (LEFM) Law".

Compared with ISO 13586.2018, this document has a lot of structural adjustments. For a list of structure number changes between the two documents, see

Appendix A.

The technical differences between this document and ISO 13586.2018 and their reasons are as follows.

--- The chapter "Symbols" (see Chapter 4) has been added to facilitate the operator to understand and use this document;

--- Replaced ISO 2818 (see 5.2) with the normatively quoted GB/T 39812 to adapt to my country's technical conditions and increase operability

active;

--- Replaced ISO 9513 (see 7.1, 7.3) with the normatively quoted GB/T 12160-2019 to adapt to the technical conditions of our country,

Increase operability;

--- Replaced ISO 7500-1 (see 7.1, 7.2) with the normatively quoted GB/T 16825.1-2022 to adapt to the technical requirements of our country

pieces to increase operability;

--- Replaced ISO 527-1 (see 9.4) with the normatively quoted GB/T 1040.1 to adapt to my country's technical conditions and increase operability

active;

--- Replaced ISO 604 (see 9.4) with the normatively quoted GB/T 1041 to adapt to my country's technical conditions and increase operability.

The following editorial changes have been made to this document.

--- Some explanatory content of the text is changed to Note (see Chapter 1).

Please note that some contents of this document may refer to patents. The issuing agency of this document assumes no responsibility for identifying patents.

## 1 Scope

This document describes a method for the determination of the fracture toughness of plastics under given conditions and the mode of crack opening (mode I). In order to adapt to different

With different types of equipment or different types of materials, two test methods with pre-cracked specimens are described, namely the three-point bending test and compact specimen tension

test.

This document applies to the following materials, including composite materials containing short fibers with a length less than or equal to 7.5 mm.

--- Rigid and semi-rigid thermoplastic molding, extrusion and casting materials;

--- Rigid and semi-rigid thermosetting molding and casting materials.

Note 1. It is generally believed that short fibers with a length of 0.1 mm to 7.5 mm will cause heterogeneity and anisotropy in the crack tip region during the fracture process. Appendix B mentions

Provides an extension of the applicability of the same test procedure to rigid and semi-rigid thermoplastic or thermoset plastics containing such short fibers under defined conditions test.

Note 2. Since the model adopted assumes that the cracked material has linear elastic properties and the crack tip is in a state of plane strain, in order to ensure the validity of the test

In order to be effective, certain restrictions are added to the linearity of the force-displacement curve, the width and thickness of the specimen (see 9.4). Cracks are sharp enough to prevent sharper cracks

Streaks lead to significantly lower measurement performance values.

## 2 Normative references

The contents of the following documents constitute the essential provisions of this document through normative references in the text. Among them, dated references

For documents, only the version corresponding to the date is applicable to this document; for undated reference documents, the latest version (including all amendments) is applicable to

this document.

GB/T 1040.1 Determination of tensile properties of plastics - Part 1. General principles (GB/T 1040.1-2018, ISO 527-1:2012, IDT)

GB/T 1041 Determination of compression properties of plastics (GB/T 1041-2008, ISO 604:2002, IDT)

GB/T 12160-2019 Calibration of extensometer systems for uniaxial testing of metallic materials (ISO 9513:2012, IDT)

GB/T 16825.1-2022 Inspection of static uniaxial testing machines Part 1. Tensile and (or) compression testing machines force measuring system

Inspection and Calibration (ISO 7500-1:2018, IDT)

GB/T 39812 Machining preparation of plastic samples (GB/T 39812-2021, ISO 2818:2018, IDT)

### 3 Terms and Definitions

The following terms and definitions apply to this document.

#### 3.1

energy release rate  $G$

The expansion of the crack area ( $\Delta A$ ) causes the change of the external work ( $\Delta U_{ext}$ ) and the strain energy ( $\Delta U_s$ ) of the deformed body, and the calculation is shown in formula (1).

$G =$

$\frac{\Delta U_{ext}}{\Delta A} -$

$\frac{\Delta U_s}{\Delta A}$

(1)

Note: In joules per square meter ( $J/m^2$ ) as the unit.